UNIVERSITI PUTRA MALAYSIA

PRODUCTION AND PRODUCT DEVELOPMENT NATURAL SPRAY-DRIED PANDAN (PANDANUS AMARYLLIFOLIUS) POWDER

LOH SENG KEAN.

PRODUCTION AND PRODUCT DEVELOPMENT OF NATURAL SPRAY-DRIED PANDAN *(PANDANUS AMARYLLIFOLIUS)* POWDER

By

LOH SENG KEAN

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Master of Science

March 2005

DEDICATION

To My Parents

One who ever shared a moment of his love and
one who has strived patiently for their beloved children

Abstract of the thesis presented to the senate of Universiti Putra Malaysia
in fulfilment of the requirements for the degree of Master of Science

PRODUCTION AND PRODUCT DEVELOPMENT NATURAL SPRAY-DRIED PANDAN *(PANDANUS AMARYLLIFOLIUS)* POWDER

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LOH SENG KEAN

March, 2005

Chairman : Professor Yaakob Bin Che Man, PhD.

Faculty : Food Science and Technology

A study was performed to optimize the production process of encapsulated pandan powder using response surface methodology (RSM). The study was inclusive of an evaluation of two types of carbohydrates, namely maltodextrin and gum arabic, in the production of encapsulated pandan powder as an encapsulator. A product development of home made pandan ice cream was carried out to evaluate the effectiveness of encapsulated pandan powder as an ingredient in food.

An optimum condition for production of encapsulated spray dried pandan powder was established. Inlet temperature of 170°C and speed rate of 6 rpm with constant outlet temperature of 90°C were shown to be the optimum conditions to produce encapsulated pandan powder. A combination of maltodextrin and gum arabic in the formulation of spray dried encapsulated pandan powder in terms of physico-chemical properties and sensory scores was also carried out.

A pandan flavored ice cream using encapsulated pandan powder as a colouring and flavouring agent was successfully developed. The optimum condition for formulation of pandan ice cream using spray dried encapsulated pandan powder was established. Pandan powder concentration of 3.41% and sugar concentration of 3.45% were shown to be the most acceptable conditions to produce pandan flavored ice cream.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains

PENGHASILAN DAN PENGEMBANGAN PRODUK SERBUK PANDAN (PANDANUS AMARYLLIFOLIUS) ASLI YANG DIHASILKAN SECARA SEMBURAN KERING

Oleh

LOH SENG KEAN

Mac, 2005

Pengerusi : **Profesor Yaakob Che Man, PhD.**

Fakulti : **Sains Makanan dan Teknologi**

Satu kajian telah dijalankan untuk mengoptimumkan proses penghasilan serbuk pandan secara penyemburan sembur dengan menggunakan 'response surface methodologi' (RSM). Kajian telah dijalankan untuk menilai kesesuaian dua jenis karbohidrat yang berlainan seperti maltodekstrin dan gam arabik dalam penghasilan serbuk pandan. Kajian ini juga merangkumi pengembangan produk, iaitu ais krim pandan untuk menguji keupayaan serbuk pandan yang dihasilkan sebagai salah satu ramuan dalam ais krim.

Keadaan yang optimum untuk menghasilkan serbuk pandan secara penyemburan telah berjaya ditentukan, Suhu dalaman pada 170°C dan kadar kelajuan pada 6 rpm dengan suhu luar‿n yang tetap pada 90°C, keadaan-keadaan yang ptimum

untuk menghasilkan serbuk pandan. Ramuan yang menggunakan campuran maltodekstrin dan gam arabik telah memberi keputusan yang lebih baik berbanding dengan hanya menggunakan maltodekstrin atau gam arabik secara berasingan dalam formulasi untuk menghasilkan serbuk pandan secara penyemburan kering.

Ais krim pandan yang menggunakan serbuk pandan secara penyemburan kering sebagai pewarna dan perisa juga telah berjaya dihasilkan. Keadaan yang optimum untuk formulasi ais krim pandan yang menggunakan serbuk pandan telah dikenalpasti. Kepekatan serbuk pandan pada 3.41% dan kepekatan gula pada 3.45% merupakan kombinasi (gabungan) paling sesuai untuk menghasilkan ais krim pandan.

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I certify that an Examination Committee met on 14th March 2005 to conduct the final examination of Loh Seng Kean on his Master of Science thesis entitled "Production and Product Development of Natural Spray-dried Pandan (*Pandanus amaryllifolius*) Powder" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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I certify that an Examination Committee met on 14 March 2005 to conduct the final examination of Loh Seng Kean on his Master of Science thesis entitled "Production and Product Development of Natural Spray-dried Pandan (*Pandanus amaryllifolius*) Powder" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulation 1981. The committee recommended that the candidate be awarded the relevant degree. Members of the Examination Committee are as follow:

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This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirements for the degree of Master Science. The member of the Supervisory Committee are as follow:

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Date: 17 NOV 2005

DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions

LOH SENG KEAN

Date: 14/3/06

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CHAPTER 1

INTRODUCTION

In Malaysia, many fruits, plants, spices and herbs contain natural flavouring and colouring compounds. The leaves of pandan (*Pandanus amaryllifolius*) have a strong aroma and are widely used in South East Asia as flavouring compounds for various food products, such as bakery, sweets and even home cooking. The preparation of pandan extract for cooking is troublesome and difficult, since it involves many steps such as washing, trimming, blending and filtration. With this reason, Malaysian tends to search for alternative way to overcome this problem by using artificial pandan flavour and artificial green colour from the market. These artificial colour and flavour are use because these products are convenience as compared to the traditional way of preparing the pandan extract.

In recent years, natural food ingredients have been recognized for their health-promoting qualities. Therefore, much interest has been devoted to preparing flavouring and colouring compounds from natural sources by extraction, purification, and isolation (Al-Kahtani *et al.*, 1990; Jiang, 1999). Continued interest in natural compounds by consumers showed that they are just as concerned about their health as they are about the quality of the foods they consume (CAP, 1999). Nowadays, the main challenges in the production of powders are the development of specialties and the reduction of processing costs. Therefore, it is important that standard/optimum operation criteria and processing conditions be established that will ensure a prime quality feature of dried powder products during processes.

Drying is an ancient process used to preserve foods. It is the most common food preservation process (Raiti, 2001). Laterally hundreds of variants are actually used in drying of particulate solids, pastes, continuous sheets, slurries or solutions, where it provides the most diversity among food engineering unit operations (Cohen *et al.*, 1995). The quality of food powders is based on a variety of properties depending on the specific application. In general, the final moisture content, insolubility index, rheological properties and bulk density are of primary importance (Straatsma *et al.*, 1999).

Today, various drying methods such as spray- and drum-drying have been applied to produce encapsulated flavouring and colouring powder (Reineccius, 1991; Che Man *et al.*, 1999). These powdered products have been widely used in ice cream, yogurt, soup, cake, tea, 'nasi lemak', andd even 'seri kaya' (Che Man *et al.*, 1999).

Spray drying is one of the most practical method by which a solution of solids in water can be dehydrated to a solid final product. Other methods for the removal of water from such solutions, such as freeze-drying, are usually much more expensive whereas a method like liquid-liquid extraction requires the use of solvents which is often undesirable (Lijn, 1976). Spray drying is the most common technique to produce flavour powders in a few seconds (Hidefumi *et al.,* 2001). Many investigations have been carried out on the influence of drying operational conditions and the composition of wall materials on the retention and shelf life of encapsulated flavours (Hidefumi *et al.*, 2001).

Microencapsulation is a process by which particles of sensitive or bioactive materials are packed into thin films of a coating material. The films formed around the encapsulated material (the core) are called the wall system (Shahidi *et al.*, 1993). The wall protects the core material against deterioration (Shahidi *et al.*,1993; Beatus *et al.*, 1985; Dziezak *et al.*, 1988; Rosenberg *et al.*, 1988; Jackson *et al.*, 1991). Microencapsulation is also used to transform liquids into dry, free flowing powders, enhance handling properties, limit losses of volatile materials and control release of active material (Moreau *et al.*, 1993; Balassa *et al.*, 1971; Bakan *et al.*, 1973; Bakan *et al.*, 1978; Taylor *et al.*, 1983; Karel *et al.*, 1988; Frede *et al.*, 1991; Lauren *et al.*, 1991; Pauwels *et al.*, 1991; Rosenberg *et al.*, 1993; Onwulata *et al.*, 1994).

Flavours are encapsulated for a number of reasons. One of the most important reasons is to retain them in a food product during storage. Flavours are volatile and thus would readily evaporate from food matrix during storage (Reineccius *et al.*, 1991). Maltodextrins and gums are all used as encapsulated substrates (Zeller *et al.*, 1999). It is apparent that each carbohydrate has its own strengths and weaknesses for flavour encapsulation (Reineccius *et al.*, 1991). Maltodextrins is very cost effective while gum arabic is a good compromise in characteristics offering good emulsion stability, retention and protection against oxidation. Blends of gum arabic and maltodextrins are particularly interesting, since they will offer the strengths of acacia gum plus a potential cost saving. Some studies with maltodextrins and gum arabic have indicated that blends containing up to 60% maltodextrin with 40% gum arabic can be used to encapsulate flavours and offer excellent stability to oxidation (Reineccius *et al.*, 1991).

Optimization of the dehydration process is performed to ensure rapid processing conditions yielding an acceptable quality product and a high throughput capacity (Madamba, 2002). Rapid food engineering operation such as dehydration reduces the overall cost of operation or processing; however, adverse reactions occur to biological products being dried (Baloch *et al.*, 1973; Aguilera, 1989; Madamba, 2002). These are loss of vitamins, undesirable colour, development of off-flavours, volatilization of flavour compounds, solubility changes and loss of essential amino acids. When many factors and interactions affect desired responses, response surface methodology (RSM) is an effective tool for optimizing the process

(Giovanni, 1983; Rustom *et al.*, 1991). The basic principle of RSM is to relate product properties by regression equations that describe relationships between input parameter and product properties (Thakur *et al.*, 2000).

Therefore, the objectives of this study were:

i. To optimize operational parameters in the production of dried pandan powder using spray dryer.

ii. To evaluate the suitability of two types of carbohydrates as encapsulating agent in the production of pandan powder.

iii. To develop a pandan flavoured ice cream using the spray dried pandan powder.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Pandan

The genus Pandanus of the Pandanaceae comprises 500 known species, 52 of which are endermic in the Philippines. A certain degree of confusion is found in the nomenclature of Pandanus species, since several names are known for the same species. The genus is not well studied chemically with only four species reported in the literature. *Pandanus tectorius* and *Pandanus latifolius* were found to contain sterols and the terpine, linalool, respectively (Nonato *et al.*, 1993; Macleod *et al.*, 1982). Alkaloid have been detected in *Pandanus amaryllifolius* and identified by X-ray diffraction. Structure of pandamarine is shown in Figure 2.1. *Pandanus amaryllifolius* commonly known as 'pandan-mabango' or fragrant screwpine, is used popularly as a flavouring for rice because it emits a peculiar odour similar to 'ambermohor' rice and 2-acetyl-1-pyroline is the flavouring agent for 'ambermohor' rice (Nonato *et al.*, 1993). The structure of 2-acetyl-1-pyroline is shown in Figure 2.2.

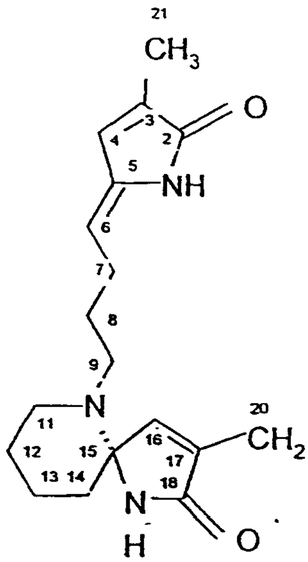

Figure 2.1: Pandanmarine

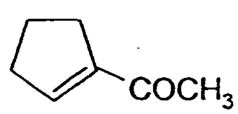

Figure 2.2: 2-acetyl-1-pyrroline

(Source: Nonato *et al.*, 1993)

2-Acetyl-1-pyrroline was identified in pandan leaves by Buttery *et al.* (1982) and Lakasanalamai and Ilangantileke (1993). This heterocyclic compound was believed to be the important compound responsible for the characteristic aroma of several Asian aromatic rice varieties. Using NMR techniques, Nonato *et al.* (1993) identified three piperidine alkaloids in pandan leaves: pandamarilactone-1, pandamarilactone-32 and pandamarilactone-31. Their biogenetic origin and taxonomic implication were discussed.

2.1.1 Synonyms

Table 2.1 shows the synonyms of pandan (*Pandanus amaryllifolius*) which are the common name of pandan leaves in different languages (Katzer, 2004).